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Research Article

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Effect of mineral enriched compost on soil microbiological properties

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Summary

Two years field experiments were conducted at the Indian Institute of Rice Research Farm, Hyderabad, to compare the performance of field fortified poultry manure applications on some of the microbiological properties of soil. Continuous application of MEC treatments resulted in decline in the pH of the soil in all the treatments from the initial levels of 8.07. Analysis of post harvest soils of MEC for physical parameters revealed that plots treated with inorganic fertilizer alone had an adverse effect on soil dehydrogenase activities, soil phosphatase activites and soil microbial carbon. Soil microbial biomass C µg C/g soil dry wt was recorded in all the MEC plots compared to control and RDF. Soil enzyme observations such as Alkaline phosphatase µg p-nitrophenol/g soil/ha assayed in all the MEC plots were highly skewed. Lowest value of dehdrogenase µg TPF/g soil/24h activity was observed in the RDF plots. Higher values of soil dehdrogenase activities were recorded in all the MEC plots compared to control and fertilized plots.

Key words : Mineral enriched compost, Dehydrogenase activities, Phosphatase activities, Soil microbial carbon

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Introduction

Micro-organisms are a component of the 'biological engine of the earth' and play a role in driving many fundamental nutrient cycling processes, soil structural dynamics, degradation of pollutants and provide various other services in the soil ecosystem. Despite their small volume in soil, micro-organisms are key players in the cycling of nitrogen, sulphur and phosphorus and the decomposition of organic residues affecting nutrient and carbon cycling on a global scale. Micro-organisms are further associated with the transformation and degradation of waste materials and synthetic organic compounds. The bioavailability of chemicals, e.g. heavy metals or pesticides, is also dependent on soil microbial activities. In addition, micro-organisms also affect the physical properties of soil by the production of extra-cellular polysaccharides and other cellular debris by micro-organisms which help in maintaining soil structure, as these materials function as cementing agents that stabilise soil aggregates. Thereby, they also affect water holding capacity, infiltration rate, crusting, erodibility, and susceptibility to compaction.

IIRR through an in house project has formulated a strategy of scaling down the use of fertilizer especially N,P with the use of poultry manure and vermi manure. Poultry manure obtained from PDP, Hyderabad was

fortified with 10 per cent and 20 per cent of urea and SSP and the resulting product was formulated as a cost effective treatment for meeting the crop N and P requirement in rice. The field fortified product was labeled as enriched nitrogen and phosphorus poultry manure and was designed for field application to irrigated field conditions. Two years of field trial has proved that it is possible to obtain a productivity of 3-4t/ha of rice productivity with both hybrid and high yielding varieties with substantial improvement in soil quality parameters. The same plots were studied in great details about changes in microbiological properties of soils with the continued two years of MEC application.

Resource and Research Methods

Two years field experiments were conducted at the Indian Institute of Rice Research farm, Hyderabad, India on a deep black clayey vertisol (Typic Pellustert) to compare the performance of field fortified poultry manure applications on two rice varieties. The I.I.R.R. plot selected for the purpose was D-7 with a soil pH of 8.07; containing 1.24 per cent organic matter; available N at 191 kg ha^{-1}; available P at 25 kg ha^{-1} and available K at 389 kg ha^{-1}. Furthermore, available calcium and magnesium levels were high and available sulphur was low (8 kg ha^{-1}). Soil levels of the micronutrients Zn and Cu were high and Fe and Mn status was low. The field experiment was made up of ten treatments that included different levels of field fortification of poultry as well as vermi manure with 10 and 20 per cent of total nitrogen and phosphorus requirement to be met with urea and superphosphate applications on two rice varieties-one the hybrid KRH2 and the other the high yielding variety Krishnahamsa.The experimental design was Randomized Block with three replicates of plot size 7.6 m^2 giving an overall total of 60 plots. A recommended dose of fertilizers (RDF) of total 120:80:60 (N:P:K) was taken as conventional treatment and one absolute control was maintained to observe the significant differences. Every year soil samples were collected to analyze soil microbiological parameters. Soil dehydrogenase assay was determined by the method described by Casida (1977). Excel software was used for data analysis.

Research Findings and Discussion

Through analytical data, it was observed that the plots treated by inorganic fertilizer and control plots showed lowest values of organic carbon as 0.49 and 0.51 per cent, respectively (Table 1). A large variation of post harvest soil organic carbon status was noticed amon all other MEC treated plots. This had an important bearing on all the microbiological properties of the plot treated organically or with combination of both organic as well as inorganic. Soil pH varied from 6.8 to 7.6 with a mean of 7.1. Post harvest soil organic carbon status ranged from 0.5 to 1.1 per cent with a mean of 0.8 per cent. Higher values of organic carbon status was recorded as vermin and poultry manure contains higher carbon in its manorial composition. Very high soil microbial biomass C µg C/g soil dry wt was recorded in

Table 1 : Comparative study of MEC treatments on soil microbiological properties

Treatments	Soil pH	OC (%)	Soil microbial biomass C µg C/g soil dry wt	Alkaline phosphatase µg p-nitrophenol/g soil/h	Dehydrogenase µg TPF/ g soil/24h
T_1 Absolute control (Native fertility)	6.79	0.49	209.72	368.86	159.13
T_2 2T/ha vermi manure + 10%N (Nitro. compost)	7.15	0.55	339.73	356.24	177.55
T_3 2T/ha vermi manure +20%N (Nitro. compost)	7.22	0.88	368.47	285.21	189.86
T_4 2T/ha vermi manure + 10%P (Phospho. compost)	7.25	0.78	308.29	272.76	132.69
T_5 2T/ha vermi manure + 20%P (Phospho. compost)	6.85	0.89	312.81	314.42	177.11
T_6 2T/ha poultry manure + 10%N (Nitro. compost)	6.94	0.67	342.45	331.06	170.42
T_7 2T/ha poultry manure + 20%N (Nitro. compost)	7.15	0.88	338.99	333.03	208.01
T_8 2T/ha poultry manure + 10%P (Phospho. compost)	7.35	1.01	327.01	323.03	143.34
T_9 2T/ha poultry manure + 20%P (Phospho. compost)	7.56	1.11	330.28	327.24	167.77
T_{10} Recommended dose of fertilizer	7.02	0.51	225.46	313.47	114.86
Range	6.8-7.6	0.5-1.1	209.7-368.5	272.8-368.9	114.9-208.0
Mean	7.1	0.8	306.8	322.2	163.6
STD	0.2	0.2	51.8	28.9	27.6
C.V. (%)	3.3	27.5	16.9	9.0	16.9

all the MEC plots compared to control and RDF. Soil enzyme observations such as alkaline phosphatase µg p-nitrophenol/g soil/ha assayed in all the MEC plots were highly skewed. Lowest value of dehdrogenase µg TPF/ g soil/24h activity was observed in the RDF plots. Higher values of soil dehdrogenase activities were recorded in all the MEC plots compared to control and fertilized plots (Table 1). Increased availability of substrates (C and N) required for microbial population build up could be the probable reason for this (Bunemann *et al*., 2006). Higher microbial diversity in organically managed soils was reported by Rao (2005) and enhanced soil biological activity in the form of microbial biomass, respiration and dehydrogenase activity in organic addition was reported by Carpenter-Boggs *et al.* (2000). Application of organic fertilizers has also been reported to enhance the population of indigenous phosphate solubilizing bacteria (Lal *et al*., 2000). With regard to dehydrogenase activities, soil microbial biomass carbon and biomass nitrogen, there was a significant increase in all the MEC treated plots though the values were highly skewed. Higher microbial biomass carbon and nitrogen in soil under organic farms compared to conventional farms managed with chemical inputs were reported by Liebig and Doran (1999). Enzyme activities in soil were also influenced by different MEC treatments. Dehydrogenase activity, which is an indicator of total microbial activity and protease, the starting enzyme for N mineralization were all significantly higher in treatment with fortified manures. Such increases in extra cellular enzyme activities (alkaline phosphatase, protease and β-glycosidase) have been reported to be higher in soils under organic management than under conventional management because the addition of organic amendments activates micro-organisms to produce enzymes (Melero *et al*., 2008). The increase in soil microbiological parameters in organic treatments indicates greater soil microbial activity. Addition of organic sources provide a stable supply of C and energy for micro-organisms and cause an increase in the microbial biomass pool. Several authors have also observed higher microbial activity in organically managed soils than in conventionally managed soils (Carpenter-Boggs *et al*., 2000; Castillom and Joergensen, 2001; Rupela *et al*., 2005 and Kang *et al*., 2005) due to additional carbon inputs in organically managed soils.

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